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whole earth crust. There come to mind the suggestions of George Darwin as to the possibility of tidal waves in the earth crust as orogenic forces that would cause an equatorial N-S direction in the folds and a NE direction in the northern hemisphere; and those of Douvillé and Prinz who would explain, one the prevailing E-W, the other the N-S directions of many of the mountain ranges of post-Proterozoic time by a former greater velocity of revolution (Suess). It would seem that these belts of Pre-Cambrian folds lend themselves still more readily to an explanation by one or the other of these factors than do the post-Proterozoic more local fold systems. Since the Pre-Cambrian folding both in America and Eurasia has a southerly component (thrust from SE and SW), a retardation of the revolution of the Earth and a resulting wandering of the crust towards the poles seems to be indicated.

On the other hand, it must also be asked whether the world-wide folding of the Archean basement complex could not be explained by simply terrestrial forces. In this connection the result of close mapping of the Pre-Cambrian folds, carried out in late years in Bohemia and Scandinavia is of great importance. It brings out closely compressed folds, whose strikes are tortuous and wavy curves and often subcircular and even angularly broken lines. This, it has been concluded, points to a tangential pressure, acting from all sides on an earth crust of fairly uniform composition (Uhlich), a pressure and a composition that could be found only in Pre-Cambrian or rather Archean time, and that means a uniform contraction of the entire earth crust such as could not be invoked for the post-Proterozoic mountain systems. If this view should supply a competent explanation for the world-wide Archean folding, it still leaves unaccounted for the presence of large systems of uniform folding, which, as we have already seen suggests the view that in Proterozoic and even in Archeozoic time the crust was separated into masses that correspond in position if not in area and configuration to the continents of Paleozoic and more recent time.

THE INORGANIC CONSTITUENTS OF LOBSTER SHELLS

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In the course of an extensive investigation relative to the inorganic constituents of marine invertebrates, by Clarke and Wheeler,¹ it was found that among the distinctly magnesian organisms the proportion of magnesia was dependent upon the temperature of the water in which the animals live. The cold water animals contained much less magnesium carbonate than those

from warm waters; a relation which was strikingly manifest in the analyses of echinoderms and alcyonarians and which has been amply verified by a considerable number of new analyses made since the original memoir was published. In other groups of organisms the same relation was suggested, but not actually proved to hold, for there were exceptions that needed explanation. In a series of eleven analyses of crustaceans (crabs, lobsters, shrimps etc.), the same variation in magnesia was strongly indicated, but with irregularities which appeared to require further investigation. It was conceivable that different parts of a shell or skeleton might differ in composition, or else that variations might be due to differences in age. It had already been found in the case of two sea urchins that the spines contained much less magnesia than the main body of the shells, but the question relative to age remained to be investigated.

Through the kindness of Dr. H. M. Smith, director of the U. S. Bureau of Fisheries, the large claws of two lobsters (*Homarus americanus*) from a single locality, Boothbay Harbor, Maine, were obtained, one from a small lobster, the other from a large specimen. The analyses gave the following results, after rejecting organic matter and water and recalculating to 100 %

	SMALL LOBSTER	LARGE LOBSTER
SiO ₂ + (Al, Fe) ₂ O ₃	0.19	0.81
MgCO ₃	6.02	11.51
CaCO ₃	80.52	64.37
CaSO ₄	1.29	1.85
Ca ₃ P ₂ O ₈	11.98	21.46
	100.00	100.00

The difference between these two analyses is very great, the large animal being much more highly magnesian and phosphatic than the small one. Unfortunately, however, the actual sizes of the two lobsters were not given, and more precise data were evidently desirable. Accordingly Dr. Smith had fragments from three lobsters sent to us, all from the same station as the others, with definite figures as to length and weight. The fragments, moreover, in each case represented both the large claw and the carapace, so that variations in the individual as well as variations in age could be determined. The analyses, six in number, were as follows:

1. Small lobster, length $8\frac{1}{2}$ inches, weight 10 ounces.
2. Medium lobster, length $11\frac{1}{2}$ inches, weight 2 pounds.
3. Large lobster, length $16\frac{1}{2}$ inches, weight $5\frac{1}{2}$ pounds. The claw is indicated by a, the carapace by b.

	1a	1b	2a	2b	3a	3b
SiO ₂ + (Al,Fe) ₂ O ₃	0.33	0.35	0.36	0.66	0.31	0.57
MgCO ₃	10.81	7.74	11.28	8.12	10.99	8.77
CaCO ₃	72.41	78.98	55.46	70.58	56.89	65.14
CaSO ₄	1.24	1.23	2.12	1.58	2.32	2.32
Ca ₃ P ₂ O ₈	15.21	11.70	30.78	19.06	29.49	23.20
	100.00	100.00	100.00	100.00	100.00	100.00

In each case the claw is richer in magnesium carbonate and calcium phosphate than the carapace. The variations due to age appear more distinctly when the average of each pair of analyses is taken, as follows:

	1	2	3
MgCO ₃	9.27	9.70	9.88
CaCO ₃	75.69	68.02	61.01
Ca ₃ P ₂ O ₈	13.45	24.92	26.35
CaSO ₄	1.24	1.85	2.32

Here the progressive increase in magnesium carbonate and calcium phosphate is clearly shown; and it also appears in the percentages of calcium sulphate, although the last detail is less significant. The smallest lobster, moreover, differs in the composition of its inorganic portion from that of the two larger animals much more than they do from each other.

From the evidence now at hand it seems clear that some of the departures from regularity in the proportions of magnesium carbonate in the shells or skeletons of marine invertebrates are due to one or both of the two causes which were suggested at the beginning of this paper. It is desirable, therefore, in further investigations of this kind, that in the study of the more highly specialized organisms the analyses should represent the totality of the inorganic portions, and that animals of the same degree of maturity should be taken. With the lower classes of organisms the difficulties are not so great, and regularities are much more easily discovered.

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¹ Clarke and Wheeler, *Prof. Paper*, No. 102, U. S. Geological Survey, Washington.